

BABINSKI'S SIGN IN DIPHTHERIA.

By J. D. ROLLESTON, M.D.,
Assistant Medical Officer, Grove Fever Hospital, London.

AMONG the by no means numerous observers who have investigated the condition of the plantar reflex in acute infections, comparatively few have noted the presence of an extensor response. Thus Stanley Barnes, writing in 1904, from negative results obtained in septicæmia, pyæmia, malignant endocarditis, pneumococcal and other forms of pneumonia and enteric fever, concluded that the toxines of the various micro-organisms which give rise to these diseases cannot alter the character of the plantar reflex. Livierato, in 1907, in a study of the reflexes in typhoid fever, lobar pneumonia, erysipelas, influenza, acute rheumatism, and measles, stated that Babinski's sign was negative in every case. On the other hand, Léopold Lévi, in a paper read before the Société de Neurologie, in 1900, stated that he had found Babinski's sign present in 10 out of 20 cases of typhoid fever, and in 1906 the present writer found it in 4 out of 46 cases of this disease. Kiroff, in a communication to the above-mentioned Society in 1905, was the first to record an extensor response in scarlet fever. His observations were confirmed by C. Rolleston in 1908, who found it in 84 out of 185 cases. Gouget, on the other hand, in a recent study of scarlet fever states, that he was unable to confirm the results of these observers, but adds that none of the cases which he examined were fatal. The presence of Babinski's sign in diphtheria was first recorded by Kiroff in the communication already mentioned, and has since been alluded to by the present writer, who, in 1906, noted its unusual frequency in cases of precocious paralysis of the palate, and in 1908, in haemorrhagic diphtheria.

The present paper is based on observations made on 877 cases of diphtheria in which the plantar reflex was investigated in the course of the last four years. An extensor response of the great toe with extension or flexion of the other toes was found to be present for varying periods in 172 cases, or 19.6 per cent.; in 29 flexion alternated with extension; and in 676 the normal flexion was present. The absence of any response was not observed in any case. Special care was taken by varying the

intensity of the stimulus to eliminate voluntary movements, so as to avoid mistaking for abnormal what was really a physiological movement of defence. Owing to the occurrence of Babinski's sign after large doses of strychnine (Babinski, Collier), it should be stated at the outset that no case had been treated with this drug. None of the cases which exhibited the extensor response showed any other signs of disease of the pyramidal system, nor was the response seen with special frequency in rickety children or in those who had learnt to walk late. High temperature and delirium, which are the usual associates of severe scarlet fever, and as such were present in Kiroff's cases, are exceptional in diphtheria, and were therefore found in very few of the present series. The character of the reflex was by no means the same in all cases. In some it was the deliberate movement indistinguishable from that met with in organic diseases of the pyramidal system, in others it more closely resembled the infantile response in the briskness with which all the toes were extended, while others showed an intermediate character.

In 33 cases the extensor response was at first bilateral, and afterwards was present on one side only before it was replaced by flexion. In 27 cases the extensor response was unilateral from the first, being present on 19 on the right, in 8 on the left side only. A transitional stage of one or more days was often observed, in which any of the following responses might be seen :—

1. All the toes yielded a flexor response, but the flexion of each hallux was less decided than that of the other toes.
2. The response was at first flexor, but prolonged stimulation produced extension of each hallux or of all the toes.
3. Alternate extension and flexion similar to what occurs normally in the development of the healthy child.

In many cases, however, none of these transitional stages was noted, and a well-marked extensor response present one day would be succeeded on the following by the normal flexion.

Age.—The systematic observations carried out independently of one another on a large number of children by Lovett Morse, Cattaneo, A. Léri, and Engstler agree in showing that though an extensor response is exceptional after the first year, no pathological significance can be attached to Babinski's sign

before the third year of life, after which date extension of the great toe is abnormal. The annexed table of the patients' ages shows that comparatively few infants are represented, so that the existence of the normal response cannot be attributed to an incompletely developed pyramidal tract.

TABLE I.

Years.	Cases examined.	Babinski cases.	Percentage.
0-1	2	2	100·0
1-2	33	12	36·36
2-3	65	17	26·1
3-4	98	28	28·5
4-5	111	24	21·6
5-6	162	29	17·9
6-7	104	24	23·07
7-8	82	16	19·5
8-9	45	7	15·5
9-10	37	5	14·05
10-20	100	8	8·0
20-50	38	0	0
	877	172	

It will be seen that the number of cases in the fourth year exceeds that met with in the third. Subsequently the frequency of the cases showing an extensor response gradually declines, and after the eighth year there is a decided fall. The duration of the sign is very brief at and after this age. In only three such cases did it persist after the throat became clean, and in two of these it was superseded by flexion on the following day.

Sex.—The sexes were almost equally affected, there being only a slight preponderance of the sign among females. 88, or 17·8 per cent., were males; 83, or 19·09 per cent., were females.

Duration.—Babinski's sign in diphtheria is essentially a phenomenon of the acute stage. In the great majority of cases it is replaced by a flexor response in convalescence. Thus out of 155 cases in which the plantar reflex was investigated throughout the disease, in 60 extension was replaced by flexion before the throat became clean; and in 9 the flexor response returned on the same day as the membrane disappeared, and in 62 in periods

ranging from one to forty-six days later. Of the remaining 24, 17 preserved the extensor response until death, which occurred between the fourth and fifteenth days of disease, and 7 until their discharge from hospital, which took place five to seven weeks after the throat had become clean. Although none of these cases showed any other signs of pyramidal disease, the duration of their extensor response exceeded that observed in a case of organic hemiplegia following diphtheria, in which the phenomenon was present for only twenty days (v. *Review*, 1905, p. 722). It may be mentioned that some of L. Lévi's typhoid patients also left the hospital two months after the onset of the disease with the sign still present. Similar cases of a persistent extensor response in the absence of other evidence of pyramidal disease were noted by C. Rolleston in scarlet fever. In some cases of the present series, after return of the normal plantar reflex, the supervention of an acute disease such as scarlet fever or a severe serum reaction was followed by the reappearance of Babinski's sign, which was replaced by flexion on subsidence of the acute attack.

Relation to Initial Attack.—The frequency and duration of an extensor response in diphtheria bear a direct relation to the character of the initial angina in exactly the same way that affection of the tendon jerks and actual paralysis are more common after severe than after mild diphtheria. This is clearly shown in the following table:—

TABLE II.

Character of diphtherial attack.	Cases examined.	Babinski cases.	Percentage.	Average duration.
Severe .	329	106	32.2	18.0 days.
Moderate .	174	25	14.3	6.7 ,
Mild .	374	41	10.9	3.9 ,
	877	172		

The severity of the Babinski cases is further shown by the fact that their mortality was 19.1 per cent. as compared with a mortality of 8.5 per cent. among the 877 cases.

As was to be anticipated from the foregoing remarks, the frequency and severity of the characteristic complications of diphtheria were above the average in the Babinski cases.

Thus among the 877 cases there were 167 paralysis cases, or 19.04 per cent., 65, or 7.4 per cent. of which were severe, while among the Babinski cases there were 53 paralysis cases, or 30.8 per cent., 28, or 16.2 per cent. of which were severe. So with albuminuria. The percentages of Babinski cases with this complication was 65.6, as compared with a percentage of 50.0 among all the cases.

A certain degree of prognostic value therefore attaches to the presence of Babinski's sign in diphtheria. On the other hand, as the figures above show, the phenomenon, though more frequent in severe cases, is by no means their exclusive appanage, nor is it to be regarded as of such unfavourable import as precocious paralysis of the palate, as the mortality of cases with this symptom ranges from 35 to 40 per cent.

Relation to Knee and Ankle Jerks.—The following figures show that, contrary to the findings of Kiroff in scarlet fever, in which all the Babinski cases showed an abolition of the knee jerks, in diphtheria these reflexes were present in the majority of cases. This is due to the fact that, as was shown by H. Mackenzie in 1890, early loss of knee jerks in diphtheria, except in fatal cases, is very rare. Babinski's sign being essentially a phenomenon of the acute stage, it is obvious that loss of tendon jerks is seldom associated with an extensor response.

As was shown in a previous paper by the writer, the frequency of affection of the ankle jerks was less than that of the knee jerks.

TABLE III.

	Condition of knee jerks, lost or sluggish.	Condition of ankle jerks, lost or sluggish.
Total number of cases examined } 905	46.9 per cent.	37.01 per cent.
Babinski cases 172	39.5	34.3

It must be understood that these figures apply to the condition of the tendon jerks only during the time that the extensor response was obtained. In a considerable number of cases the knee and ankle jerks were active at an early stage of the disease, but were subsequently lost or rendered sluggish, so that affection

of these reflexes in the Babinski cases followed to their termination was decidedly above the average, as is shown in the following table:—

TABLE IV.

	Condition of knee jerks, lost or sluggish.	Condition of ankle jerks, lost or sluggish.
Total number of cases examined	905	46.9 per cent.
Babinski cases followed to their ter- mination	155	60.0 , , 50.0 , ,

Though the knee and ankle jerks were sometimes unusually brisk during the acute stage of diphtheria, true ankle clonus was never elicited. In three cases only a spurious clonus was obtained. Babinski himself was the first to draw attention to this dissociation of the extensor response and ankle clonus, and stated that though exaggeration of the tendon reflexes and ankle clonus were frequently associated with his sign, one may exist without the other. It may be added that ankle clonus, which is not infrequent in typhoid fever, was present in only five of the Babinski cases in that disease recorded by Lévi, who also draws attention to this dissociation.

Diagnostic Importance.—The extensor response is by no means pathognomonic of diphtheria among the acute infections. Its occasional presence in typhoid fever and scarlatina has already been mentioned. The writer has also found it in two out of six cases of lobar pneumonia admitted to hospital as typhoid fever, and Van Epps records a case where a typical Babinski's sign was found in a man suffering from phthisis, although he had no history nor physical signs of any organic nervous lesion. In spite of the fact that an extensor response may be met with in other and possibly all acute infections, it is less common in non-diphtheritic angina than in diphtheria. Out of 100 cases admitted to hospital certified to be suffering from diphtheria, but subsequently to be found to have other diseases, such as follicular tonsillitis, quinsy, and Vincent's angina, only

11 yielded an extensor response, thus showing the predilection of the diphtheria toxine for the nervous system. The presence of Babinski's sign in a case of doubtful angina may therefore be accorded a certain diagnostic value.

Pathogeny. — The transitory character of the extensor response in diphtheria renders it unlikely that any considerable change should have occurred in the pyramidal tract. A temporary perturbation is probably caused by the circulating toxines, as was suggested by Lévi in the case of typhoid fever and by Kiroff in scarlatina. The pyramidal system is affected in a similar manner to, though in a less degree than, the heart and kidneys, and the occurrence of Babinski's sign may be regarded as an outward manifestation of the reaction of the pyramidal tract to infection. In this connection it is well to recall that Babinski himself declared that the "toe phenomenon" may be determined by a perturbation in the pyramidal system, independent of its duration, intensity, and extent, and that it may sometimes constitute the only indication of this perturbation. This change in the character of the plantar reflex is all the more likely to occur in young persons whose pyramidal tracts, like the rest of their nervous system, are in a state of unstable equilibrium, which is liable to be upset by various influences. A reversion to the early type of response may be brought about not only by disease, but also by normal sleep. In sleeping children up to the age of eight years, according to Stanley Barnes, or twelve years, according to Collier, an extensor response may sometimes be obtained which in the waking state is replaced by flexion.

The transient affection of the pyramidal system in acute infections, as manifested by the extensor response, may be compared with the varying degree of meningeal involvement which lumbar puncture has shown to exist in these diseases to a much greater extent than was once imagined. In most of these cases there is not so much a meningitis as a meningeal reaction, which is indicated by some degree of hypertension or a slight lymphocytosis of the cerebro-spinal fluid. Complete recovery in such cases is the rule, but it is conceivable that the meninges may subsequently form a locus minoris resistentiæ. In like manner, in cases of acute infection showing Babinski's sign, the affection of the pyramidal tract, though ephemeral, may possibly predispose

this region to further attacks, and so account for certain nervous sequelæ of the specific fevers.

The possibility of an association of a meningeal reaction with Babinski's sign in diphtheria is a question which could only be settled by lumbar puncture on a large number of cases, which, in the absence of any therapeutical indication, could not be regarded as justifiable.

SUMMARY.

1. Babinski's sign was found in a considerable percentage (19.6 per cent.) of all cases of diphtheria, the character of the response being rapid, deliberate, or intermediate in character.

2. The extensor response in diphtheria is not confined to infants, but may be obtained, though with decreasing frequency and duration, especially after the eighth year, until adult life.

3. It is essentially a phenomenon of the acute stage, in most cases being replaced by flexion in convalescence. Transition stages often exist in which various forms of response may be obtained.

4. Babinski's sign is not pathognomonic of diphtheria among the acute infections, since it occurs in typhoid fever, scarlatina, lobar pneumonia, and probably other acute diseases; but its greater frequency in diphtheria than in non-diphtheritic angina accords the sign a certain diagnostic value.

5. It is more frequent and persistent in the severe than in the mild forms of diphtheria, as is shown by the character of the angina, the higher mortality, and greater frequency of paralysis and albuminuria among the cases in which it occurs. Its presence has, therefore, a certain prognostic value.

6. It is not associated with any special condition of the tendon jerks, and is never accompanied by ankle clonus.

7. It is probably due to a transitory perturbation of the pyramidal system by the circulating toxines, comparable to the slight degree of meningeal reaction which is a frequent occurrence in acute infections.

REFERENCES.

1. Babinski. *Semaine méd.*, 1898, p. 321.
2. Barnes (Stanley). *Review of Neur. and Psych.*, 1904, p. 345.
3. Cattaneo. "Jahrb. f. Kinderheilk." lv., 1902, S. 458.
4. Collier. *Brain*, 1899, p. 71.

5. Engstler. *Wien. klin. Woch.*, 1905, S. 568.
6. Gouget. *Rev. de Méd.*, 1910, p. 323.
7. Kiroff. *Rev. Neurol.*, 1905, p. 1119. (Soc. de Neurol.)
8. Léri. *Ibid.*, 1903, p. 689.
9. Lévi (L.). *Ibid.*, 1900, p. 1005. (Soc. de Neurol.)
10. Livierato. "Gazz. degli Osp." 1907, p. 1062 (abstr. in *Rev. of Neur. and Psych.*, 1907, p. 910).
11. Mackenzie (H.). *St Thomas's Hosp. Rep.*, xxi., 1890, p. 120.
12. Morse (J. L.). "Pediatrics," xi., 1901, p. 13.
13. Rolleston (C.). *Quart. Journ. Med.*, i., 1908, p. 117.
14. Rolleston (J. D.). "A Note on the Tendo Achillis Jerk in Diphtheria," *Brain*, 1905, p. 68; "Diphtheritic Hemiplegia," *Rev. of Neur. and Psych.*, 1905, p. 722; "Precocious Paralysis of the Palate in Diphtheria," *ibid.*, 1906, p. 608; "Notes on Hæmorrhagic Diphtheria," *Metrop. Asylums Board Rep.*, 1908; "Diphtheritic Paralysis," *Practitioner*, i., 1909, p. 110.
15. Van Epps. *Journ. Nerv. and Ment. Dis.*, 1901, p. 216.

